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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/608,948

06/26/2003

Valery M. Dubin

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09/25/2006

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EXAMINER

MENZ, DOUGLAS M

ART UNIT

PAPER NUMBER

2891

DATE MAILED: 09/25/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/608,948

Applicant(s)

DUBIN ET AL.

Examiner

Douglas M. Menz

Art Unit

2891

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 29 August 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-5,7,8 and 22-26 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-5,7,8,22 and 23 is/are rejected.
- 7) ☒ Claim(s) 24-26 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 26 June 2003 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                       | 5) <input type="checkbox"/> Notice of Informal Patent Application                       |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-2 and 7-8 are rejected under 35 U.S.C. 102(b) as being anticipated by Lur et al. (US 5413962).

Regarding claim 1, Lur discloses an apparatus comprising:

a first layer (30) having a first at least one interconnect (26) formed in an interlayer dielectric (30, Figs. 1-11 and Cols. 2-4);

a second layer (on top of 30 bound by top of 34, Fig. 2-6) formed over the first layer, the second layer having a second at least one interconnect (29, Figs. 5-11), and wherein the second layer comprises a first sublayer (42, Fig. 11) and a second sublayer (85, Fig. 11), the first sublayer (42, Fig. 11) is between the first layer (30, Fig. 11) and the second sublayer (85, Fig. 11), and the second sublayer (85, Fig. 11) is between the first sublayer (42, Fig. 11) and the third layer (bound by 60 and top of 34 top of Fig. 10), the first sublayer (42, Fig. 11) comprising an ILD, and the second sublayer (85, Fig. 11) comprising air (Cols. 2-4);

a third layer (bound by 60 and top of 34 top of Fig. 10) formed over the second layer, the third layer defining at least one air gap (85, Fig. 11) between the second at least one interconnect (29, Fig. 11) and the third layer (Fig. 11 and Cols. 2-4);

and at least one shunt (40, 50) comprising a first material different from a second material of the first and second at least one interconnects (26, 29 respectively, Fig. 11) selectively covering the first and second at least one interconnects (Fig. 11), wherein the first material has a property that inhibits electromigration or diffusion of the second material into the second layer or third layer (*Examiner's position is that since 40, Fig. 11 caps 26, Fig. 11, it has the property that inhibits diffusion of the second material 26 into the third layer i.e. by physically imposing a barrier between the third layer*).

Regarding claim 2, Lur further discloses comprising a barrier layer (42) to support the first and second at least one interconnects (Fig. 11 and Col. 4, lines: 20-30).

Regarding claim 7, Lur further discloses wherein the second at least one interconnect (29, Fig. 11) is within the second sublayer (85, Fig. 11).

Regarding claim 8, Lur further discloses wherein the second layer comprises air (85, Fig. 11).

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 3-5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lur et al. (US 5413962) in view of Dubin et al. (US 6696758).

Regarding claim 3, Lur discloses the features of claim 2 as mentioned above, however, Lur does not explicitly disclose wherein the barrier layer has a thickness of between 50-500 Angstroms. Dubin discloses an interconnect structure which incorporates a barrier layer (140, Fig. 1) that has a thickness of 100-500 Angstroms (Col. 3, lines: 45-65). It would have been obvious to one of ordinary skill in the art at the time of the invention to use Dubin's barrier layer with its disclosed thickness for the

purpose of inhibiting interconnect material diffusion as taught by Dubin (Col. 3, lines: 50-55).

Regarding claims 4-5, Lur discloses the apparatus of claim 1 as mentioned above and further discloses at least one via having a via plug (26 or 29), however, Lur does not explicitly disclose further the via plug material is selected from the group consisting of cobalt and nickel or that the via plug is deposited using electroless deposition.

Dubin discloses an interconnect structure which incorporates a via plug material that is selected from the group consisting of cobalt and nickel (Col. 5) and that the via plug is deposited using electroless deposition (Col. 7). It would have been obvious to one of ordinary skill in the art at the time of the invention to use a via plug material that is selected from the group consisting of cobalt and nickel and that the via plug is deposited using electroless deposition with Lur's structure for the purpose of improving the structural properties of the interconnect structure as taught by Dubin (Col. 2).

Claims 22-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lur et al. (US 5413962).

Regarding claims 22-23, Lur discloses the apparatus of claim 1 as mentioned above and further that the first material comprises aluminum, aluminum alloy, tungsten, copper or silver (Col. 3) Lur does not explicitly disclose wherein the first material

Art Unit: 2891

comprises one of nickel, cobalt, a nickel alloy and a cobalt alloy or that the material comprises an electroless conductor. It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate such materials into Lur's apparatus because such materials are well known in the art to be used for interconnection structures.

***Allowable Subject Matter***

Claims 24-26 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Regarding claim 24, there is no teaching or suggestion in the art of record disclosing the apparatus of claim 1, wherein the second at least one interconnect comprises a metal exposed to the at least one air gap.

Regarding claim 25, there is no teaching or suggestion in the art of record disclosing the apparatus of claim 3, wherein the barrier layer carries an electrical current between a first shunt covering the top of the first interconnect and a second shunt covering the top of the second interconnect.

Regarding claim 26, there is no teaching or suggestion in the art of record disclosing the apparatus of claim 2, wherein the barrier layer comprises one of electroless nickel and electroless cobalt.

### ***Response to Arguments***

Applicant's arguments filed 8/29/06 have been fully considered but they are not persuasive. Applicant has amended claim 1 to include the limitation "wherein the first material has a property that inhibits electromigration **or** diffusion of the second material into the second layer or third layer" and argues that Lur's layer 40 and 50 can not protect against electromigration as required by claim 1. Examiner agrees with such assessment, however, Lur's layer 40 would still have the property **that inhibits diffusion** of the second material into the third layer.

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Douglas M. Menz whose telephone number is 571-272-1877. The examiner can normally be reached on M-F 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bill Baumeister can be reached on 571-272-1722. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.



Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

DM

*Dan My 9/17/06*